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Articles

The Value Of Small Size: Loss Of Forest Patches And Ecological Thresholds In Southern Madagascar

Örjan Bodin¹, Maria Tengö, Anna Norman, Jakob Lundberg, and Thomas Elmqvist

Department of Systems Ecology, Stockholm University, 106 91 Stockholm, Sweden

Many services generated by forest ecosystems provide essential support for human well-being. However, the vulnerability of these services to environmental change such as forest fragmentation are still poorly understood. We present spatial modeling of the generation of ecosystem services in a human-dominated landscape where forest habitat patches, protected by local taboos, are located in a matrix of cultivated land in southern Madagascar. Two ecosystem services dependent on the forest habitats were addressed: (1) crop pollination services by wild and semidomesticated bees (Apoidea), essential for local crop production of, for example, beans, and (2) seed dispersal services based on the presence of ring-tailed lemurs (*Lemur catta*). We studied the vulnerability of these ecosystem services to a plausible scenario of successive destruction of the smallest habitat patches. Our results indicate that, in spite of the fragmented nature of the landscape, the fraction of the landscape presently covered by both crop pollination and seed dispersal services is surprisingly high. It seems that the taboo system, though indirectly and unintentionally, contributes to upholding the generation of these services by protecting the forest patches. Both services are, however, predicted to be very vulnerable to the successive removal of small patches. For crop pollination, the rate of decrease in cover was significant even when only the smallest habitat patches were removed. The capacity for seed dispersal across the landscape displayed several thresholds with habitat patch removal. Our results suggest that, in order to maintain capacity for seed dispersal across the landscape and crop pollination cover in southern Androy, the geographical location of the remaining forest patches is more crucial than their size. We argue that in heavily fragmented production landscapes, small forest patches should increasingly be viewed as essential for maintaining ecosystem services, such as agricultural production, and also should be considered in the ongoing process of tripling the area of protected habitats in Madagascar.

Keywords: [forest fragmentation](#), [graph](#), [habitat loss](#), [pollination](#), [seed dispersal](#), [small habitats](#), [southern Madagascar](#)

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